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PENSOFT

First record of the vulnerable freshwater fish *Lobocheilos falcifer* (Valenciennes, 1842) (Teleostei, Cyprinidae) in Sumatra, Indonesia

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Abstract. *Lobocheilos falcifer* (Valenciennes, 1842) is a freshwater fish endemic to the island of Java, Indonesia, and has been assessed as Vulnerable according to the International Union for the Conservation of Nature criteria. In May 2022, a male specimen of *L. falcifer* was collected in the Way Sekampung River, Lampung Province, Sumatra, Indonesia. This represents the first record of this species outside of Java. This new record expanded the species distribution about 300 km to the north, and to an additional island within the Indonesian archipelago. The occurrence of this species on the island of Sumatra likely changes its conservation status; thus, new conservation actions may be more appropriate for the species and its known populations. The presence of *L. falcifer* on separate islands indicates that biogeographic interpretations of Indonesian fishes may change and highlights the need for urgent study of freshwater biodiversity in the region.

Keywords. Biogeography, distribution range, endemic fish, Labeoninae, rare fish

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Introduction

Lobocheilos Bleeker, 1854 is a cyprinid genus native to Southeast Asia and Borneo, Java, and Sumatra, in the western Indonesian archipelago (Kottelat and Tan 2008; Ciccotto and Page 2016; Ciccotto and Tan 2018; Hasan et al. 2021a). *Lobocheilos* species are freshwater benthic fishes, having a torpediform body and a subterminal mouth specialized to scrap algae from the substrate; they usually are found in fast-flowing rivers (Kottelat and Tan 2008; Ciccotto and Tan 2018). Two species—*Lobocheilos lehat* Bleeker, 1858 and *Lobocheilos falcifer* (Valenciennes, 1842)—are endemic to Java, one of the main islands of Indonesia (Kottelat and Tan 2008; Lumbantobing, 2019, 2020; Hasan et al. 2021a; Fricke et al. 2023). However, accurate information on the geographic occurrence and distribution of these species are scarce. *Lobocheilos lehat* is probably extinct but has been assessed as Critically Endangered according to the IUCN Red List, and it has not been sampled for over a century (Lumbantobing 2020; Hasan et al. 2021a; Fricke et al. 2023). On the other hand, *L. falcifer* has been sampled consistently, albeit infrequently, until recently. *Lobocheilos falcifer* is extremely rare and is known from very few localities in a small geographic area. It is assumed that populations are very small wherever its occurs. The localions where *L. falcifer* are known to occur have been lost or degraded by anthropogenic pressures, such as urban expansion and pollution from residences, agriculture, and industry. In addition,

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overfishing has probably contributed to local extinctions and reductions in the populations of this species. Highly efficient and non-selective electrofishing is commonly used by fishers along the fast-flowing stream habitat where this species usually occurs (Lumbantobing 2019; Hasan et al. 2021a). Due to these combined threats, *L. falcifer* is considered Vulnerable according to International Union for the Conservation of Nature (IUCN) Red List criteria (Lumbantobing, 2019). A third species of the genus, *Lobocheilos schwanefeldii* Bleeker, 1854, is also known for Java. However, it has a wider geographic distribution and also occurs in the islands of Sumatra and Borneo (Ciccotto and Tan 2018; Fricke et al. 2023).

Although *L. falcifer* only has published occurrences from Java (Kottelat and Tan 2008; Lumbantobing, 2019; Hasan et al. 2021a; Fricke et al. 2023), collections have recently been made from southern Sumatra. We publish for the first time the occurrence of *L. falcifer* on the island of Sumatra. Our new record extends the geographic distribution of *L. falcifer* to the north and to another island of the Indonesian archipelago.

Methods

A single specimen of *Lobocheilos falcifer* (Fig. 1) was collected on 15 May 2022, using a small hook, in the midstream of the Way Sekampung River, Banyumas Subdistrict, Pringsewu District, Lampung Province, Sumatra, Indonesia (Figs. 2, 3). The collection site is characterized by having slow water flow and abundant vegetation on the banks of the river (Fig. 3). The specimen was preserved in alcohol (96%) (Hasan and Tamam 2019). The specimen was deposited in the Ichthyological Collection of the Environmental and Fisheries Resources Management Laboratory (EFRM), Faculty of Fisheries and Marine, Universitas Airlangga, Surabaya, Indonesia.

The morphological inspection of the specimen followed Kottelat and Tan (2008), complemented by photographs of the life specimen which were taken immediately after capture to document colouration pattern in life.

Results

***Lobocheilos falcifer* (Valenciennes, 1842)**

Figure 1; Table 1

New records. INDONESIA – Lampung Province • Pringsewu District, midstream of the Way Sekampung River; 05°19′48″S, 104°55′19″E; 15.V.2022; H. Ayodyadana leg.; caught with a small hook; 1 ♂ (EFRM0112).

Identification. We identified our specimen *L. falcifer* (Fig. 1) based on characters proposed by Kottelat and Tan (2008) and Ciccotto and Tan (2018). This species is distinguished from its congeners from Borneo, Sumatra, and Java by the combination of the following characters: absence of dark blotch on caudal peduncle and 30–31+2–3 lateral line scales. Other useful morphological features for identification are listed below: snout pointed; mouth subterminal; four barbels, very small; dorsal-fin emarginated, origin of dorsal-fin before the

Table 1. Meristic and morphometric characters of *Lobocheilos falcifer* from the Way Sekampung River, Pringsewu District, Sumatra (present study) and Java (Kottelat and Tan, 2008).

Morphometric data	Present study, *N* = 1	Kottelat and Tan (2008), *N* = 4
Standard length, SL (mm)	171.1	83.3–115.1
Percent of SL		
Total length	137.3	134.8–137.6
Head length	25.3	25.1–25.8
Snout length	10.7	10.6–12.0
Predorsal length	44.7	44.5–46.5
Prepelvic length	51.4	51.1–52.5
Preanal length	73.0	72.6–75.0
Meristics data		
Dorsal fin rays	iii 9½	iii 8–9½
Pectoral fin rays	i 16	i 15–16
Anal fin rays	iii 5½	iii 5½
Pelvic fin rays	i, 8	i 8
Caudal fin rays	9+8	9+8
Lateral line scales	31+2	30-31+2-3
Transverse line scales	½ 5.1.5 ½	½ 5.1.5 ½

Figure 1. Specimen of *Lobocheilos falcifer*, 171.1 mm SL (EFRM112), from the Way Sekampung River, Pringsewu District, Lampung Province Sumatra, Indonesia.

origin of pelvic fins; anal fin emarginated, less tall than the dorsal fin; pectoral and pelvic fins subequal, shorter than head; caudal forked. Coloration pattern of fresh specimen: body uniformly silver and greenish from the top of the head to caudal peduncle; faint mid-lateral strip; all fin membranes colourless.

Two congeners of *L. falcifer* are also known from Sumatra: *L. schwanefeldii* and *L. ixocheilos* Kottelat & Tan, 2008. Our specimen had dorsal fin rays counts iii, 9½, lateral line scales counts 30–31+2–3, edge of lower jaw arched, and two pairs of barbels; these are features considered as diagnostic for *L. falcifer* according to Kottelat and Tan (2008) and Ciccotto and Tan (2018). *Lobocheilos falcifer* is clearly distinguished from *L. schwanefeldii* and *L. ixocheilos* in having the edge of the lower jaw arched (vs. straight in *L. schwanefeldii* and *L. ixocheilos*), lateral line scales counts 30–31+2–3 (vs. 32–33+2–3 in *L. schwanefeldii*), and two pairs of barbels (vs. one in *L. ixocheilos*) (Kottelat and Tan 2008; Ciccotto and Tan 2018).

Morphometric and meristic characters of the *L. falcifer* specimen from Sumatra are listed in Table 1.

Discussion

The discovery of *Lobocheilos falcifer* in the Way Sekampung River (Fig. 3), Lampung Province, southern Sumatra, is the first published record of this species for the island of Sumatra. Our new record represents a range extension of about 300 km to the north from the previously known occurrences of *L. falcifer*, and to an additional island (Sumatra) (Fig. 2). Based on recent records of the *Lobocheilos* distribution in Indonesia, several species are considered restricted to only one island: *L. bo* (Popta, 1904) (Borneo), *L. erinaceus* Kottelat & Tan, 2008 (Borneo), *L. lehat* (Java); *L. ovalis* Kottelat & Tan, 2008 (Borneo), *L. tenura* Kottelat & Tan, 2008 (Borneo), and *L. unicornis* Kottelat & Tan, 2008 (Borneo) (Kottelat and Tan 2008; Ciccotto and Tan 2018; Fricke et al. 2023).

This work extends the distribution of *L. falcifer* to Sumatra and, thus, contests the endemicity of this species to Java (Kottelat and Tan 2008; Ciccotto and Tan 2018; Lumbantobing 2019; Hasan et al. 2021a; Fricke et al. 2023). Therefore, we suggest that the conservation status for *L. falcifer* should be reassessed. Further research is needed to determine the population abundance and distribution across Sumatra. This should be supplemented with molecular data collected from populations to inform conservation policies and test biogeographic hypotheses.

In the past, Sumatra and Java, as well as several other islands from Southeast of Asia, formed a connected land mass called Sundaland (~11,500 Ma) (Barton et al. 2013). In addition, the southern part of Sumatra and western part of Java were once connected in the same ancient river basin, before being separated by rising sea levels (Vooris

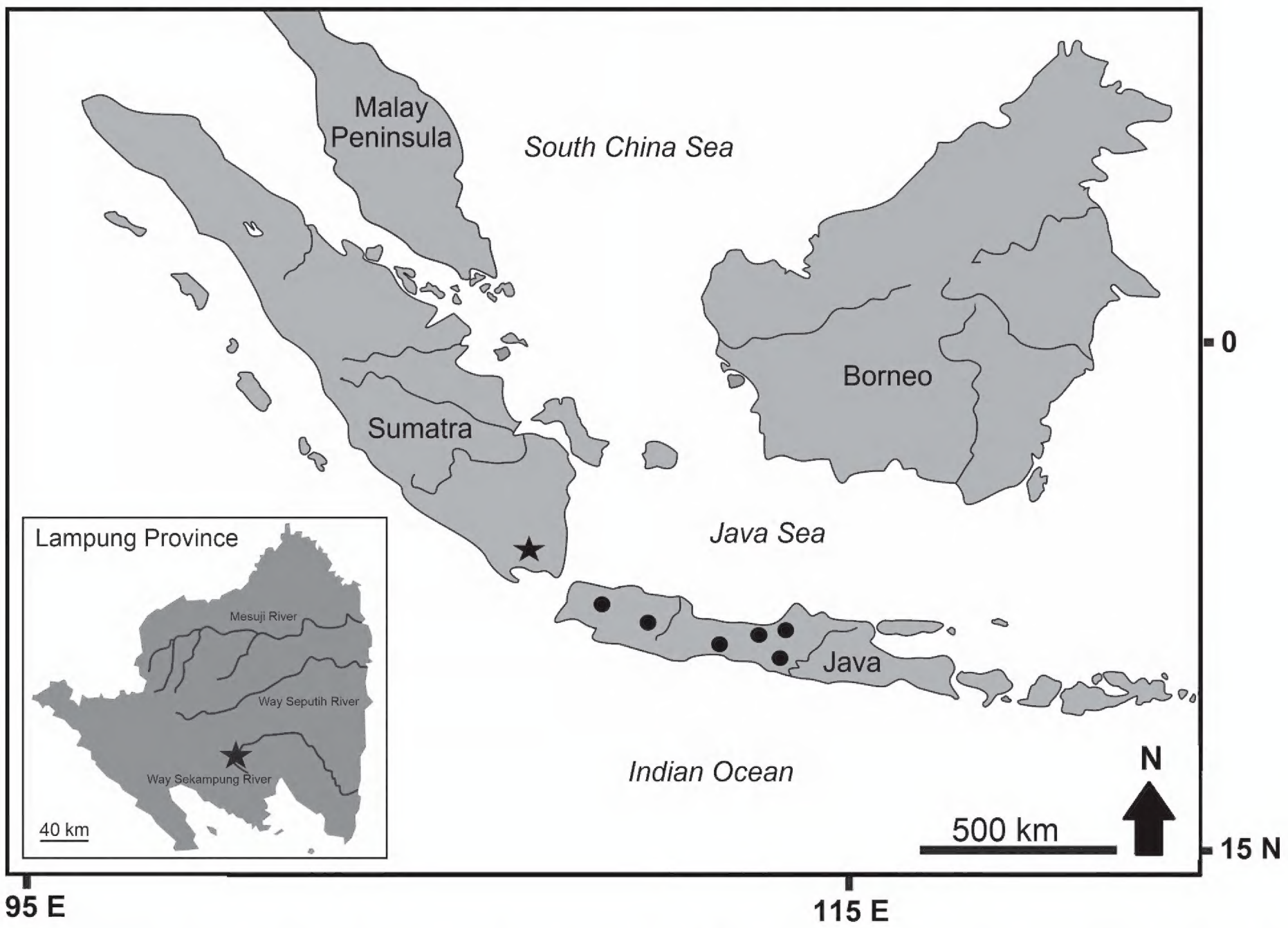

Figure 2. Distribution map of *Lobocheilos falcifer*. ★ = new record from Sumatra, Indonesia. ● = previous records based on Kottelat and Tan (2008), Lumbantobing (2019), and Hasan et al. (2021a).

Figure 3. Collection site of *Lobocheilos falcifer* (EFRM112): Way Sekampung River, in Pringsewu District, Lampung Province, Sumatra, Indonesia.

2000). These ancient connections may have favoured the dispersal of freshwater fish species, explaining the occurrence of some freshwater fish species in these currently isolated islands (see Kottelat et al. 1993), and occurrence of *L. schwanefeldii* in Borneo, Sumatra, and Java, and *L. falcifer* in Java and southern Sumatra may be examples of such past dispersal. However, molecular data and biogeographic analyses, as well as more information on these species' distributions, are necessary to corroborate this hypothesis. Assumptions around the evolutionary pressures and paleogeography that drove and shaped the current geographic distribution of island species may be tested using *Lobocheilos* species as models and compared to the drivers and events that shaped the evolution and geographic distribution of the African labeonin fishes, another group of cyprinids adapted to fast-flowing waters. For example, Tan et al. (2009) used a molecular phylogenetic analysis to argue that Labeoninae originated in East Asia, in the early Miocene (~23 Ma) during the second uplift of Qinghai–Tibetan plateau (25–17 Ma) and then started to radiate, dispersing to different areas, including Africa. *Labeo* Cuvier, 1816 and *Garra* Hamilton, 1822 are labeonine genera widely distributed in several drainages of Africa, but *Garra* is mainly found in the Nile River and Lake Victoria systems (Tan et al. 2009). Both lineages dispersed from Asia to Africa through the Arabian Peninsula, but at different times. Around 20 Ma (Early Miocene), some labeo-like lineages dispersed into East Africa, spreading into several African drainages. On the other hand, Garra-like lineages dispersed into the Nile River system area in northeastern Africa around 9 Ma (Late Miocene), and then dispersed to the other African river systems (Tan et al. 2009). This indicates that the distribution pattern and biodiversity of African labeonin fishes was shaped by events of dispersal from Asia to Africa, and then from within Africa itself (eastern and northeastern portion), to other regions of the continent. Previous assertations of biogeographic origin and evolution of freshwater fishes in the Indonesian archipelago should be reassessed. However, to conduct a similar analysis as the above-mentioned example and recover the biogeographic history of *Lobocheilos* spp., we fist need accurate information on these species' distributions, as well as molecular data.

Determining and confirming new records of threatened fish species is essential for understanding trends in species diversity and patterns of biogeography (Hasan et al. 2021b, 2020). A sound understanding of species present and the ecological requirements of each are required for successful conservation efforts. There are extremely limited data on the ecology of *L. falcifer*. However, in general, *Lobocheilos* species are benthic omnivorous cyprinids, specialised for feeding on algae by scraping it of the substrate; they prefer wider rivers with moderate- to fast- flowing, well-oxygenated water, but they also occur in large lake systems (Kottelat and Tan 2008;

Hasan et al. 2021a). Urgent action is required to fully assess *L. falcifer* and other overlooked Indonesian freshwater species.

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Author Contributions

Conceptualization: VH. Data curation: JS, FPO. Formal analysis: FPO. Funding acquisition: VH. Investigation: VH. Methodology: FPO. Project administration: VH. Validation: JS. Visualization: FPO. Writing – original draft: VH. Writing – review and editing: JS.

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